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(54) **WATER SPOUTING DEVICE**

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B01F 3/04	(2006.01)
E03C 1/04	(2006.01)
E03C 1/084	(2006.01)
E03C 1/10	(2006.01)
B05B 1/16	(2006.01)

(52) **U.S. Cl.**

CPC ***B05B 7/0416*** (2013.01); ***B01F 3/04007*** (2013.01); ***B05B 7/0425*** (2013.01); ***B05B 7/0433*** (2013.01); ***B05B 7/0458*** (2013.01); ***E03C 1/0405*** (2013.01); ***E03C 1/084*** (2013.01); ***E03C 1/102*** (2013.01); *B05B 1/1654* (2013.01); *B05B 1/1672* (2013.01)

(58) **Field of Classification Search**

CPC B05B 7/0416; B05B 1/18; E03C 1/102; E03C 1/0405; E03C 1/084; B01F 3/04007
USPC 239/428.5, 428, 397, 575, 588, 590.3, 239/600, 410
See application file for complete search history.

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(57) **ABSTRACT**

A water spouting device has a shower flow passage. A guide wall is formed in the shower flow passage. The guide wall turns only a part of a water stream flowing in from an inflow port into a guiding water stream directed to the outside.

12 Claims, 4 Drawing Sheets

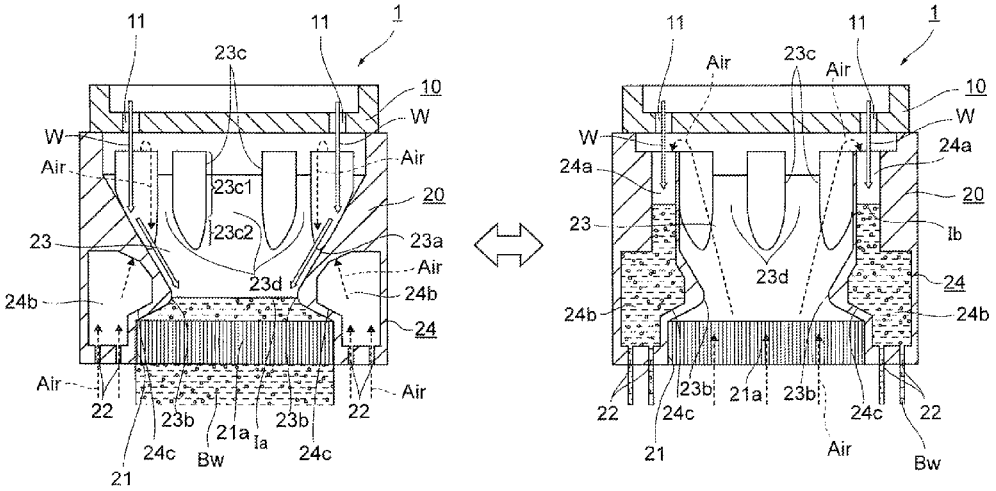


FIG. 1

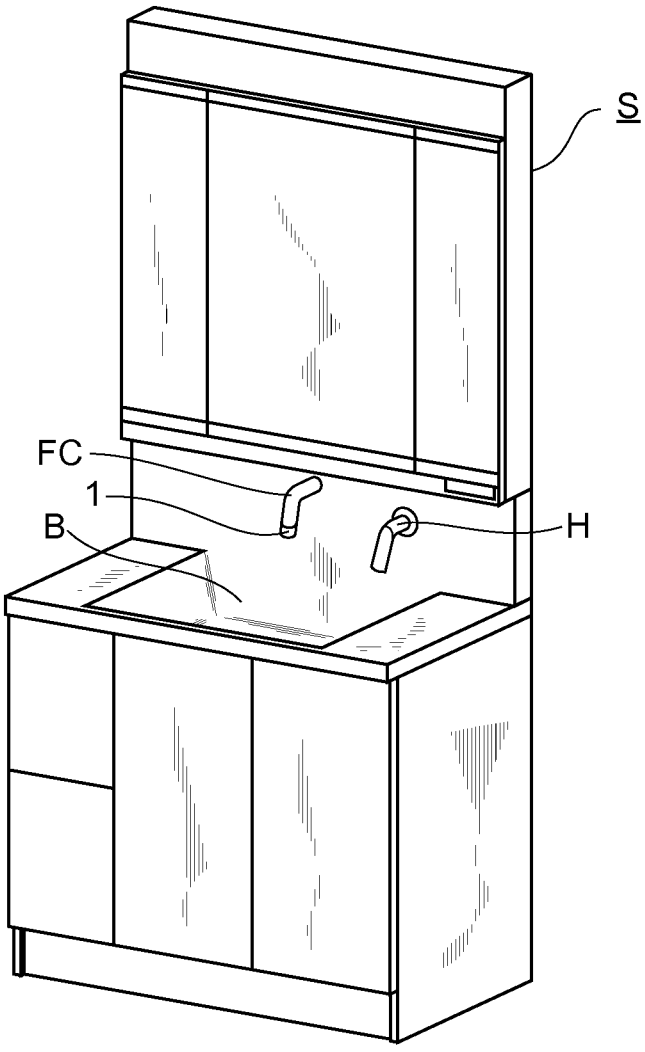


FIG. 2C

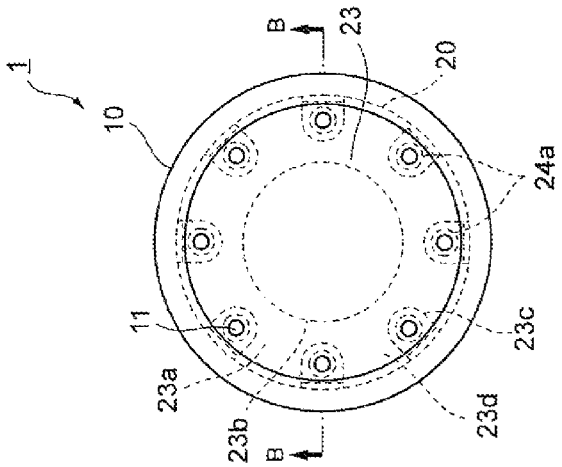


FIG. 2B

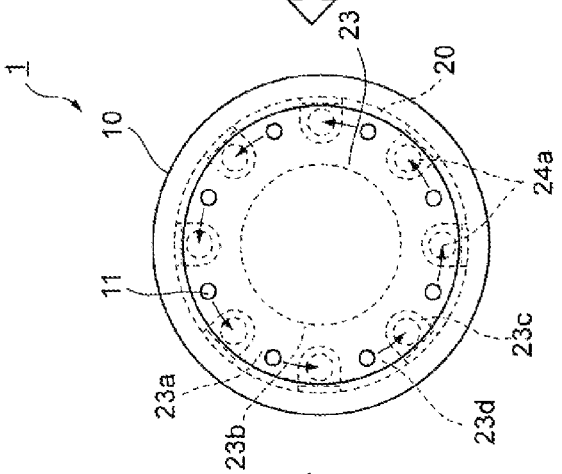


FIG. 2A

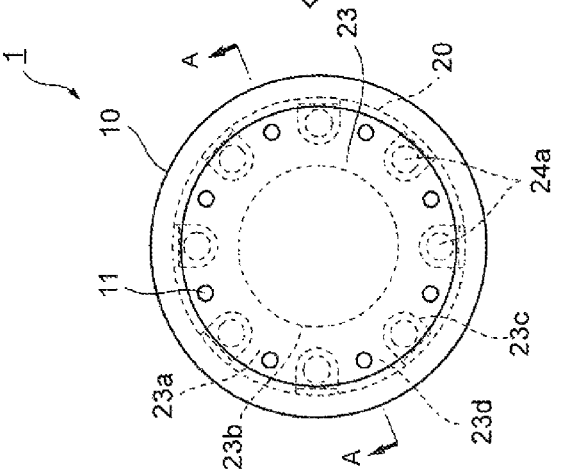
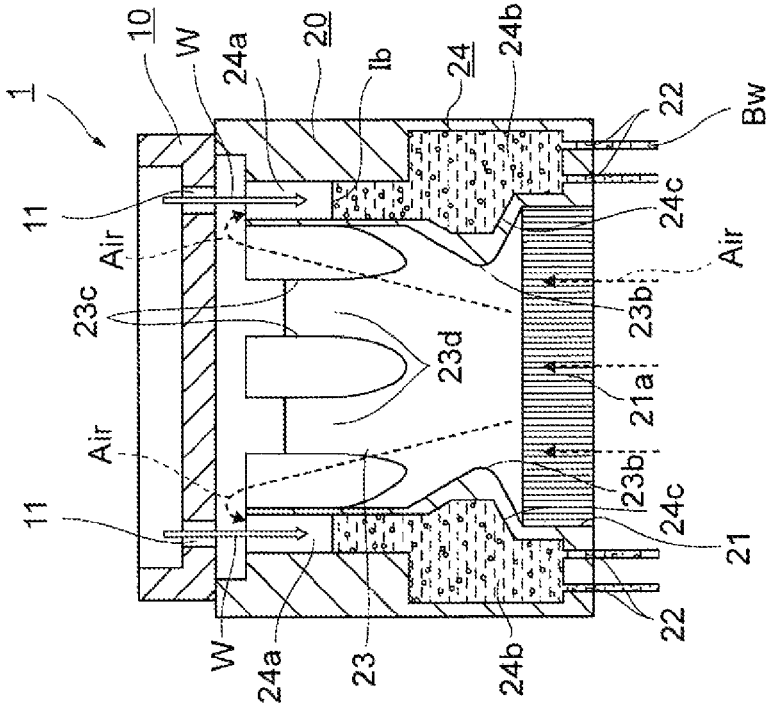


FIG. 3B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24b
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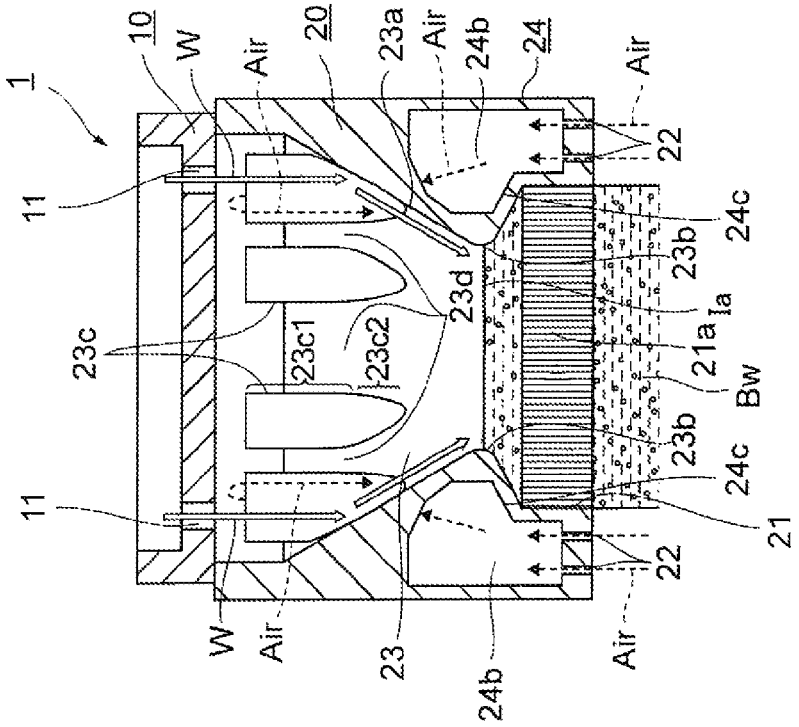
FIG. 3A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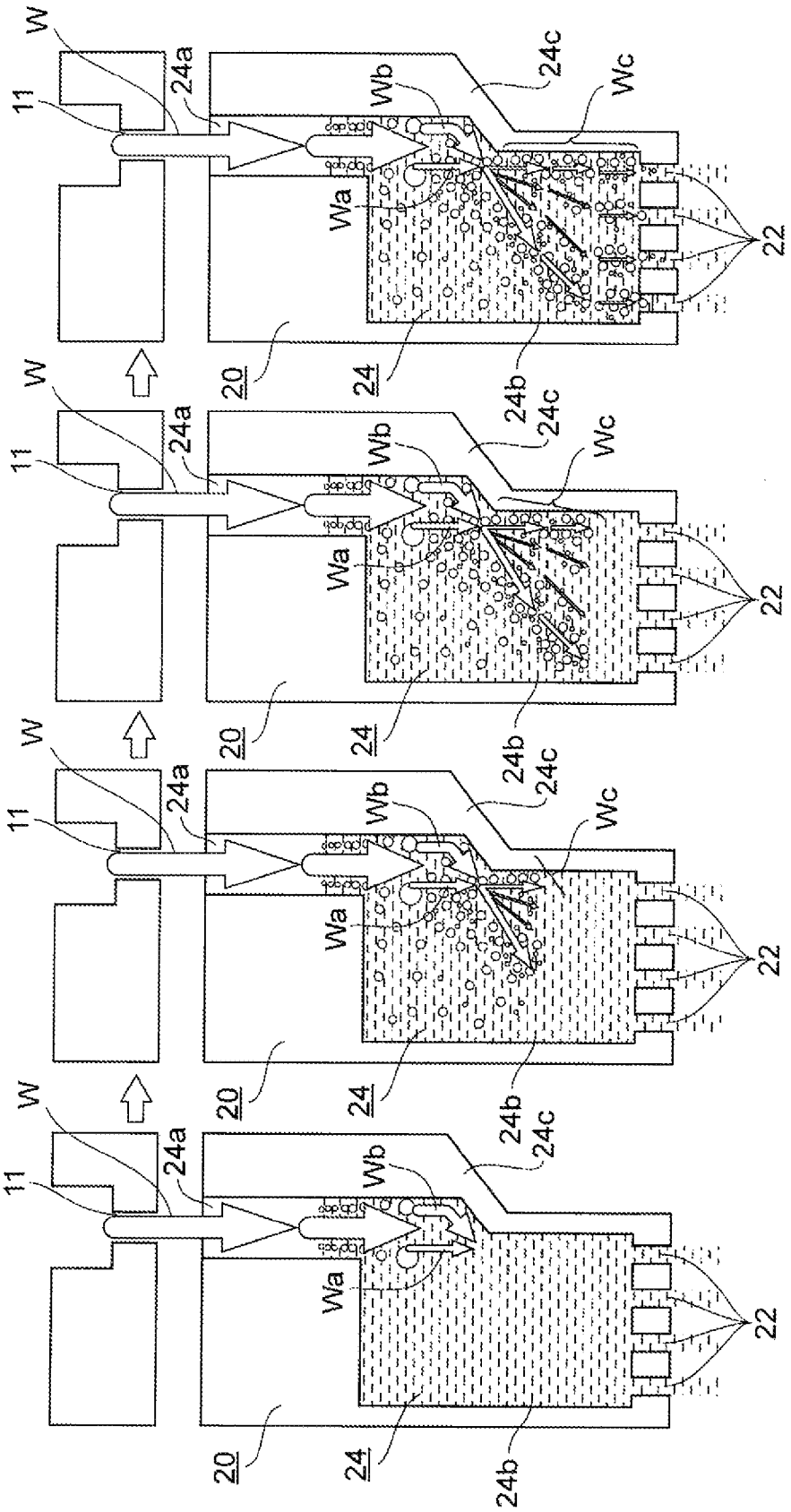

FIG. 4A

FIG. 4B

FIG. 4C

FIG. 4D

WATER SPOUTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a water spouting device which generates and spouts air bubble-entrained water by plunging water through an air-liquid interface between air and temporarily stored water.

2. Description of the Related Art

There is a water spouting device hitherto proposed which spouts air bubble-entrained water by entraining air bubbles into water to be spouted (e.g., Japanese Patent Laid-Open No. 2010-167086).

For example, the water spouting device described in the above disclosure can switch between shower water spouting of spouting water in the form of a shower and straight stream water spouting of spouting a single unified water stream. This water spouting device realizes water saving by spouting air bubble-entrained water from both spouts so as to spout large water droplets even at a low water volume while maintaining the flow velocity.

The water spouting device disclosed in Japanese Patent Laid-Open No. 2010-167086 is provided with inflow ports (jet holes), through which water flows in from a water supply source, and turns air introduced through an air intake passage into foam and entrains the air into a water stream flowing in from these inflow ports. More specifically, a negative pressure is generated in an internal space as the water from the inflow ports is jetted, and the air introduced through the air intake passage due to the negative pressure is caught in the water stream flowing in from the inflow ports and turned into fine foam before being entrained into the water. This water spouting device switches by a switching mechanism so that the air bubble-entrained water with foamy air entrained in it is spouted from shower spouts as a water stream in the form of a shower or from a straight stream spout as a single unified water stream. In such a water spouting device, the shower spouts are disposed on the outer peripheral side and the straight stream spout is disposed in a central part on the inside relative to the shower spouts, and an air intake port is provided alongside the shower spouts, separately from the shower spouts and the straight stream spout.

In the conventional technology described in the above disclosure, in the case of shower water spouting, water jetted from the plurality of internal jet holes crashes against the upper end of a separation wall surface and is separated into two water streams, and the water streams are spouted as shower spouting water through two shower spouting water flow passages. As the water is jetted from the internal jet holes, a negative pressure is generated in a space between an internal jet holes forming member (member in which the internal jet holes are formed) and a branch part forming member, and outside air is introduced through the air intake passage due to this negative pressure. The introduced outside air is caught in a water stream, which is formed of the water jetted from the internal jet holes and crashing against the upper end of the separation wall surface, and turned into fine foam and entrained into the water.

While adoption of such a configuration allows air bubble-entrained water to be spouted from the shower spouts formed around the straight stream spout, the number of shower spouts that can correspond to one internal jet hole is only two, and increasing this number may lead to uneven spouting of air bubble-entrained water.

In view of this, one can conceive of applying the mechanism of spouting air bubble-entrained water from the straight stream spout so as to omit the separation wall surface and dispose as many shower spouts as possible for one internal jet hole. One possible example of the specific configuration is a water spouting device including: a rotary member which has a straight stream spout, a shower spout disposed on the outer peripheral side of the straight stream spout, and an inflow port which is disposed on the circumference and through which water flows in from a water supply source, and which rotates around the center of the circumference as the rotational center; a straight stream flow passage extending from the inflow port to the straight stream spout; and a shower flow passage extending from the inflow port to the shower spout. When the water spouting device is used as a water faucet of a lavatory, for example, it is required to be compact in the radial direction as well as in the height direction. In order to meet the demand for compactness in the radial direction, it is preferable that the water spouting device is configured such that the inflow port is shared between straight stream water spouting and shower water spouting, and that rotating the rotary member causes water supplied from the inflow port to flow through either the straight stream flow passage or the shower flow passage.

If the separation wall surface as described in the above disclosure is omitted, it is necessary to sufficiently secure the distance from the inflow ports to the shower spouts so that the air bubble-entrained water formed in the shower flow passage spreads to each one of the shower spouts. However, given the demand for compactness in the height direction as described above, it is not always possible to sufficiently secure that distance. In order to spout the formed air bubble-entrained water from each one of the many shower spouts while reducing the distance from the inflow ports to the shower spouts, it is desirable to provide the inflow ports at positions above a region, where the shower spouts are formed, so as to achieve a balance. In one preferable example, the inflow ports are provided near the center of the region where the shower spouts are formed.

However, if the inflow ports are disposed at ideal positions (near the center in the radial direction of the region where the shower spouts are formed) relative to the shower spouts, the inflow ports are inevitably located at positions away from the straight stream spout. If the inflow ports are thus disposed on the outer peripheral side of the device, the distance from the inflow ports to the straight stream spout, which is provided at the center, becomes longer. This in turn causes the water flowing from the inflow ports to the straight stream spout to decrease in flow velocity before plunging through the air-liquid interface above the straight stream spout, which may result in a decrease in amount of air bubbles entrained into straight stream spouting water. It is therefore preferable to dispose the inflow ports at positions off-center on the straight stream spout side, taking into account a decrease in amount of air bubbles entrained into straight stream spouting water, while forming the inflow ports relatively on the shower spout side.

If the openings of the inflow ports are thus not provided directly above near the center of the region where the shower spouts are formed but disposed at positions on one side eccentric to the center in the radial direction of the shower spout, a difference occurs in the flow velocity of water streams depending on the position of the shower spout. More specifically, the flow velocity of a water stream spouted from a shower spout on one side is higher, while the flow velocity of a water stream spouted from a shower spout on the other side is lower. Moreover, when a difference in flow velocity

occurs between shower spouting water on one side and that on the other side, a slower water stream is attached to a faster water stream and the water spouted from the shower spouts becomes a single water stream, so that no water stream in the form of a shower is formed.

The present invention has been devised in view of these problems, and an object of the present invention is to provide a water spouting device which can switch between shower water spouting and straight stream water spouting and can spout air bubble-entrained water in both water spouting states, the water spouting device capable of entraining a large amount of air bubbles in both water spouting states of shower water spouting and straight stream water spouting, as well as of spouting shower water evenly at a high flow velocity.

SUMMARY OF THE INVENTION

In order to solve the above-described problems, the present invention provides a water spouting device which generates and spouts air bubble-entrained water by plunging water through an air-liquid interface between air and temporarily stored water, the water spouting device including:

a first member which has an inflow port through which water flows in from a water supply source and which jets the water toward a downstream side; and

a second member which has:

a straight stream spout which spouts air bubble-entrained water as a single unified water stream;

a shower spout which spouts air bubble-entrained water in the form of a shower;

a straight stream flow passage extending from the inflow port side to the straight stream spout; and

a shower flow passage extending from the inflow port side to the shower spout, wherein

the straight stream spout and the shower spout are disposed in coaxial circles,

changing the relative positional relation between the first member and the second member by rotating any one of the first member and the second member can switch between a first state, in which water flows through the straight stream flow passage and air is entrained into this water, and a second state, in which water flows through the shower flow passage and air is entrained into this water,

in the second state, the inflow port is disposed at a position on one end side, where the straight stream spout is disposed, eccentric to the center in the radial direction of the shower spout, and

a dispersed water stream forming part is formed in the shower flow passage, the dispersed water stream forming part turning a part of a water stream flowing in from the inflow port into a guiding water stream, which flows toward the other end side in the radial direction of the shower spout, by causing it to crash against a guide wall, while turning the rest of the water stream into a directly advancing water stream, which flows toward the one end side in the radial direction of the shower spout, without causing it to crash against the guide wall, and merging the guiding water stream and the directly advancing water stream to form a dispersed water stream.

According to the present invention, since the inflow port is disposed at a position on one side, where the straight stream spout is disposed, eccentric to the center in the radial direction of the shower spout, and since the dispersed water stream forming part is formed in the shower flow passage, it is possible to form the guiding water stream by directing a water stream flowing in from the inflow port toward the other side. Even when the inflow port is disposed at a position on one side, where the straight stream spout is disposed, eccentric to the center in the radial direction of the shower spout, it is possible to supply air bubble-entrained water toward the shower spout formed on the other side. Since the dispersed water stream forming part directs only a part of the water stream flowing in from the inflow port toward the other side, it is possible to reduce unevenness in flow velocity of water streams heading to the shower spout and to spout the water evenly.

In the water spouting device according to the present invention, it is also preferable that the shower spout is formed at a position other than a region defined by projecting the inflow port in a jetting direction.

In the water spouting device according to the present invention, it is also preferable that, an air introduction part for introducing air, a water storage part for storing air bubble-entrained water, and a backflow prevention part, which is provided between the air introduction part and the water storage part and which has a smaller flow passage cross-sectional area than the water storage part so as to prevent backflow of air bubble-entrained water from the water storage part to the air introduction part side, are formed in the shower flow passage, and

that the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the backflow prevention part toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

In the water spouting device according to the present invention, it is also preferable that the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the inflow port toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

In the water spouting device according to the present invention, it is also preferable that the dispersed water stream forming part is formed such that a part of a region, which is defined by projecting an outlet portion of the inflow port toward the downstream side and which is defined by a water stream diffusing at a spreading angle of 5 degrees after plunging through an air-liquid interface being an interface between air and air bubble-entrained water stored inside the shower flow passage, interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

In the water spouting device according to the present invention, it is also preferable that the dispersed water stream forming part is formed such that the flow rate of the guiding water stream becomes higher than the flow rate of the directly advancing water stream.

In the water spouting device according to the present invention, it is also preferable that the dispersed water stream forming part is formed such that a part of the guiding water stream is not merged with the directly advancing water stream.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing a water faucet unit on which a spout cap according to an embodiment of the present invention is mounted;

FIGS. **2**A to **2**C are schematic views showing the relation between inflow ports and shower and straight stream flow passages of the spout cap shown in FIG. **1**;

FIGS. **3**A and **3**B are schematic views showing the outline of the operation of the spout cap shown in FIG. **1**; and

FIGS. **4**A to **4**D are cross-sectional views showing the configuration of the shower flow passage of the spout cap shown in FIG. **1**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the following, an embodiment of the present invention will be described with reference to the accompanying drawings. To make the description easy to understand, the same components in the drawings will be given the same reference signs as far as possible and a repeated description thereof will be omitted.

The outline of a spout cap (water spouting device) **1**, which is one embodiment of the present invention, will be described with reference to FIG. **1** to FIG. **3**. FIG. **1** is a perspective view showing an example where the spout cap **1** is used for a washstand S as a component of a water faucet device FC. FIGS. **2**A to **2**C are cross-sectional views of the spout cap **1**. FIGS. **3**A and **3**B are schematic views showing the relation between inflow ports and flow passages for shower spouting water and straight stream spouting water of the spout cap **1**.

The spout cap **1** is a component used for a spout portion of the water faucet device FC. As one example, the water faucet device FC is mounted on a washbasin of the washstand S as shown in FIG. **1**. The water faucet device FC has an elongated cylindrical shape formed of stainless steel etc. The water faucet device FC spouts water toward a bowl section B. The bowl section B stores water spouted from the water faucet device FC or receives this water. The water faucet device FC is connected with a water pipe (not shown). The water pipe is mounted in the periphery of the bowl section B and serves as a water supply source of the water faucet device FC.

As shown in FIG. **1**, the spout cap **1** is mounted at a leading end part of the water faucet device FC. The spout cap **1** covers the leading end part of the water faucet device FC. The spout cap **1** spouts water supplied from the water pipe as shower spouting water or straight stream spouting water. The shower spouting water is composed of a plurality of thin water streams. The straight stream spouting water is composed of a single unified water stream. Both the shower spouting water and the straight stream spouting water are air bubble-entrained water which is formed as air is suctioned from the outside and the air turned into foam is entrained into the water. The spout cap **1** is configured such that rotating the leading end part thereof can switch the water spouting state of the spout cap **1** between shower water spouting and straight stream water spouting.

Next, the specific configuration and the outline of the operation of the spout cap **1** will be described with reference to FIG. **2** and FIG. **3**. The spout cap **1** has a circular cylindrical shape as a whole. The spout cap **1** is composed of a first cylinder part **10** (rotary member) and a second cylinder part **20**. In the spout cap **1**, rotating the second cylinder part **20** relative to the first cylinder part **10** can switch between shower water spouting and straight stream water spouting.

FIG. **2**A shows a first state (hereinafter referred to as a "straight stream state") in which water flows through the straight stream flow passage and air from the shower flow passage is entrained into this water. FIG. **2**C shows a second state (hereinafter referred to as a "shower state") in which water flows through the shower flow passage and air from the straight stream flow passage is entrained into this water. The state shown in FIG. **2**B is a state in the middle of switching between the state shown in FIG. **2**A and the state shown in FIG. **2**C.

FIGS. **2**A to **2**C are views of the first cylinder part **10** from the bottom side of the first cylinder part **10** (from the second cylinder part **20** side). The part indicated by the broken line is the second cylinder part **20**, and it is indicated by projecting the position of the second cylinder part **20** on the first cylinder part **10**. For the convenience of description, FIG. **2** shows how the first cylinder part **10** is rotated while the second cylinder part **20** is not moved; however, it is more common to rotate the second cylinder part **20** relative to the first cylinder part **10**. The exterior of the spout cap **1** is covered with the cylindrical water faucet device FC as described above, and FIG. **2** and FIG. **3** show the internal components with the exterior removed.

As shown in FIG. **2**, the first cylinder part **10** is provided with a plurality of inflow ports **11** (here, with eight inflow ports at regular intervals) on the circumference. Water from the water pipe being a supply source is supplied to the inflow ports **11**. The inflow ports **11** are provided along the outer periphery of the first cylinder part **10**. In the shower state shown in FIG. **2**C, the inflow ports **11** are disposed at positions communicating with a shower flow passage **24** to be described later.

The second cylinder part **20** is provided with a straight stream spout **21** and a shower spout **22**. The straight stream spout **21** spouts air bubble-entrained water as a single unified water stream. The shower spout **22** spouts air bubble-entrained water in the form of a shower. The shower spout **22** is disposed on the outer periphery of the straight stream spout **21**. The second cylinder part **20** is provided with the straight stream flow passage **23** and the shower flow passage **24**. The straight stream flow passage **23** communicates between the inflow ports **11** and the straight stream spout **21**. The shower flow passage **24** communicates between the inflow ports **11** and the shower spout **22**.

The straight stream spout **21** is formed in a central portion of the second cylinder part **20**. A stream straightening mesh **21***a* is disposed in the straight stream spout **21**. The stream straightening mesh **21***a* has a lattice-like shape, and has a large number of fine pores. Disturbance of water to be spouted from the straight stream spout **21** is suppressed as the water flows through the pores of the stream straightening mesh **21***a*. As a result, the flow of the water spouted from the straight stream spout **21** is calmed down, and water scattering on the bowl section B etc. is suppressed. In addition, the stream straightening mesh **21***a* temporarily retains water to be spouted in the straight stream flow passage **23** to be described later by giving a flow passage resistance to the water flowing into the straight stream spout **21**. An air-liquid interface to be described later is formed between this retained water and air.

The shower spout **22** is formed at the leading end of the shower flow passage **24** to be described later. The shower spout **22** is composed of a plurality of small holes, and spouts water flowing through the shower flow passage **24** as shower spouting water. The shower spout **22** also gives a flow passage resistance to the water flowing through the shower flow passage **24** and thereby imparts flow velocity to the water to be spouted. In addition, the shower spout **22**

temporarily retains the water to be spouted. An air-liquid interface to be described later is formed between this retained water and air.

The straight stream flow passage **23** is a flow passage which guides water from the inflow ports **11** toward the straight stream spout **21**. The straight stream flow passage **23** is provided with a flow passage wall **23***a* which is tapered toward the straight stream spout **21**. It is an essential requirement that the flow passage wall **23***a* is tapered toward the straight stream spout **21**. The flow passage wall **23***a* of this embodiment is provided with a constricted portion **23***b* having the minimum diameter on the upstream side of the stream straightening mesh **21***a*. The diameter of the flow passage wall **23***a* on the downstream side becomes larger from the constricted portion **23***b* toward the straight stream spout **21**.

In the straight stream flow passage **23**, a guide part **23***c* is provided so as to protrude from the flow passage wall **23***a*. The guide part **23***c* divides the straight stream flow passage **23** into a plurality of divided flow passages **23***d* on the circumference. The guide part **23***c* is composed of a plurality of (here, eight) circular cylindrical members disposed on the circumference of the straight stream flow passage **23**. The guide parts **23***c* are disposed so as to extend in the gravitational direction relative to the tapered flow passage wall **23***a*. Accordingly, the guide parts **23***c* as a whole are formed so as to be thinner on the straight stream spout **21** side than on the inflow port **11** side. In particular, the guide part **23***c* of this embodiment has a first region **23***c***1**, which is formed at a constant width from the inflow port **11** side toward the straight stream spout **21**, and a second region **23***c***2**, which becomes gradually thinner on the downstream side of the first region **23***c***1**.

The upstream side of the divided flow passages **23***d* divided by the guide part **23***c* are formed at a constant width along the first region **23***c***1** and the second region **23***c***2** described above. The downstream side of the divided flow passages **23***d* expands gradually. The divided flow passages **23***d* merge into one flow passage on the upstream side of the constricted portion **23***b*.

Thus, the divided flow passages **23***d* divided by the guide part **23***c* prevents the flow of water from the inflow port **11** toward the straight stream spout **21** from meandering along the flow passage wall **23***a*, and regulates the flow of water so that water streams flowing through the divided flow passages **23***d* do not merge with one another. Ideally, the guide part **23***c* regulates the flow of water so that the water advances linearly in the direction of the conical center of the tapered flow passage wall **23***a*. In other words, the guide part **23***c* ideally regulates the flow of water so that the water flows in the shortest distance toward the central axis of the air-liquid interface to be described later.

The shower flow passage **24** is a flow passage which guides the water from the inflow port **11**, which is formed on the inner peripheral side, toward the shower spout **22**. More specifically, the shower flow passage **24** is disposed in the second cylinder part **20** on the outside relative to the straight stream flow passage **23** across the flow passage wall **23***a*. A plurality of backflow prevention parts **24***a* is disposed on the circumference on the upstream side of the shower flow passage **24**. The backflow prevention part **24***a* is formed in a cylindrical shape so as to prevent backflow of the water from the shower spout **22** side. A water storage part **24***b* is provided on the downstream side of the shower flow passage **24**. The water storage part **24***b* penetrates a lower part of the second cylinder part **20** in a doughnut shape. The water storage part **24***b* temporarily stores water. The flow passage cross-sectional area of the backflow prevention part **24***a* is smaller than the flow passage cross-sectional area of the water storage part **24***b*.

The plurality of backflow prevention parts **24***a* (here, eight backflow prevention parts at regular intervals) is provided on the outer peripheral side of the second cylinder part **20** in alignment with the positions of the inflow ports **11** on the outer periphery. The backflow prevention part **24***a* forms the shower flow passage **24**. In the backflow prevention part **24***a*, water from the inflow port **11** flows directly downward in the gravitational direction. The wall surface of this backflow prevention part **24***a* protrudes into the straight stream flow passage **23** and thereby functions as the guide part **23***c* inside the straight stream flow passage **23**.

On the other hand, the water storage part **24***b* protrudes toward the inside of the second cylinder part **20**. This protruding portion of the water storage part **24***b* is disposed at a position corresponding to the tapered portion of the flow passage wall **23***a* of the straight stream flow passage **23**. The volume of the water storage part **24***b* is increased due to this protruding portion of the water storage part **24***b*. The protruding portion of the water storage part **24***b* protrudes to the straight stream flow passage **23** side. The constricted portion **23***b* is formed in the straight stream flow passage **23** due to this protruding portion of the water storage part **24***b*. The water storage part **24***b* is another component of the shower flow passage **24**.

The water storage part **24***b* further has an annular guide wall **24***c* (dispersed water stream forming part) on the downstream side of the protruding portion. The guide wall **24***c* is provided in the portion of the flow passage wall **23***a* expanding toward the straight stream spout **21**. This guide wall **24***c* is disposed so as to at least partially overlap the cross-section of the backflow prevention part **24***a*. Accordingly, when the water spouting state of the spout cap **1** is switched from the straight stream state to the shower state through rotation of the second cylinder part **20** of the spout cap **1**, the water flowing in from the backflow prevention part **24***a* of the shower flow passage **24** first flows directly downward and crashes against the guide wall **24***c*. In this embodiment, it is desirable that the entire water flowing from the backflow prevention part **24***a* crashes against the guide wall **24***c*. In this embodiment, it is preferable that the guide wall **24***c* and the shower spout **22** are fixedly formed, that is, for example, the guide wall **24***c* is formed of the same member as the shower spout **22** so that the guide wall **24***c* is formed as a part of the second cylinder part **20**.

The outline of the operation of the spout cap **1** configured as described above will be described using FIG. **3**. FIG. **3**A is a view showing, as the straight stream state being a first state, a water spouting state in which water W flows through the straight stream flow passage **23** and air from the shower flow passage **24** is entrained into the water W. FIG. **3**B is a view showing, as the shower state being a second state, a water spouting state in which water W flows through the shower flow passage **24** and air from the straight stream flow passage **23** is entrained into the water W.

As shown in FIG. **3**A, in the straight stream state, when the water W is supplied from the plurality of inflow ports **11** formed on the outer periphery of the first cylinder part **10**, the water W flows down in the gravitational direction into the straight stream flow passage **23** and crashes against the flow passage wall **23***a*. The water W is guided to the straight stream spout **21** side while splashing on the flow passage wall **23***a* or flowing down along the flow passage wall **23***a*.

The relation between the inflow ports **11** and the second cylinder part **20** in this straight stream state is as shown in FIG. **2**A.

During this process, the shower spout **22** functions as an air introduction port, while the shower flow passage **24** functions as an air flow passage. That is, as shown in FIG. **3**A, as the water is jetted out from the inflow port **11** toward the straight stream flow passage **23**, a negative pressure is generated in the shower flow passage **24**, and the air flows in from the shower spout **22** through the shower flow passage **24** toward the straight stream flow passage **23**. The air flows from the water storage part **24***b* through the backflow prevention part **24***a* into the straight stream flow passage **23**, and is caught in the flow of the water W and turned into foam.

As water is temporarily retained on the stream straightening mesh **21***a*, an air-liquid interface Ia is formed in the straight stream spout **21**. As the water W plunges through this air-liquid interface Ia and the air turned into foam is entrained into the water W, air bubble-entrained water Bw is generated. The air bubble-entrained water Bw passes through the stream straightening mesh **21***a* and is sequentially spouted from the straight stream spout **21**.

On the other hand, as shown in FIG. **3**B, in the shower state, when the water W is supplied from the plurality of inflow ports **11** formed on the outer periphery of the first cylinder part **10**, the water W flows down in the gravitational direction into the backflow prevention part **24***a* of the shower flow passage **24**, and is guided directly to the water storage part **24***b* located directly under the backflow prevention part **24***a*. The relation between the inflow ports **11** and the second cylinder part **20** in this shower state is as shown in FIG. **2**C.

During this process, the straight stream spout **21** functions as an air introduction port, while the straight stream flow passage **23** functions as an air flow passage. That is, as shown in FIG. **3**A, as the water is jetted out from the inflow port **11** toward the straight stream flow passage **23**, a negative pressure is generated on the straight stream flow passage **23** side and the air flows in from the straight stream spout **21** through the straight stream flow passage **23** toward the straight stream flow passage **23**. The air passes through the straight stream flow passage **23** from the stream straightening mesh **21***a* and flows into the backflow prevention part **24***a* of the shower flow passage **24**, and is caught in the flow of the water W and turned into foam.

As the water is temporarily retained in the water storage part **24***b* due to the flow passage resistance of the shower spout **22**, an air-liquid interface Ib is formed in the shower flow passage **24**. As the water W plunges through the air-liquid interface Ib and the air turned into foam is entrained into this water W, air bubble-entrained water Bw is generated. The air bubble-entrained water Bw is spouted to the outside through the shower spout **22**.

In the spout cap **1** of this embodiment, the straight stream state being the first state and the shower state being the second state as described above are realized by rotating the second cylinder part **20** relative to the first cylinder part **10** so as to shift the state shown in FIG. **2**A to the state shown in FIG. **2**C.

Next, the water flow inside the shower flow passage **24** will be described with reference to FIG. **4**. FIGS. **4**A to **4**D schematically show the cross-section of the shower flow passage **24**. FIGS. **4**A, **4**B, **4**C, and **4**D show states of the water W flowing downward from the inflow port **11** through the backflow prevention part **24***a* in a time sequence after the water W is jetted. Once the jetting of the water W reaches a steady state, the state shown in FIG. **4**D continues.

When plunging through the air-liquid interface Ib, the water W jetted from the inflow port **11** forms a water stream Wa on the outside and a water stream Wb on the inside. The inflow port **11** and the guide wall **24***c* of this embodiment are in such a positional relation that the water stream Wa does not crash against the guide wall **24***c* and the water stream Wb crashes against the guide wall **24***c*. Here, the water W flowing in from the inflow port **11** diffuses (when a water stream at a flow velocity equal to or higher than 50% of the flow velocity before the water plunges through the air-liquid interface is regarded as a diffusional stream) at the spreading angle of 5 degrees after plunging through the air-liquid interface Ib at a flow velocity within the range of 3.7-14.7 m/s (the range of flow velocities at which air can be entrained at the flow rate of 2 L/min which is used in a common water spouting device). It is therefore an essential requirement that the guide wall **24***c* (dispersed water stream forming part) is disposed relative to the inflow port **11** such that only a part of the water stream, which is formed by a region defined by projecting the inflow port **11** in the jetting direction and the region of the water stream diffusing at the spreading angle of 5 degrees after plunging through the air-liquid interface Ib, crashes against the guide wall **24***c*.

The water stream Wb functions as a guiding water stream, as it is turned in direction toward the inside upon crashing against the guide wall **24***c* and heads to the shower spout **22** at a position farther from the backflow prevention part **24***a*.

Since the water stream Wa is jetted so as not to crash against the guide wall **24***c*, the water stream Wa merges with the water stream Wb, which is a guiding water stream, from the upper side toward the lower side. Therefore, the direct-advance component of the water stream Wb is reduced due to the action of the water stream Wa which functions as a directly advancing water stream, so that the difference in velocity between the water streams is reduced. In addition, as a downward force is added by the action of a water stream We merging from above, the water streams can be dispersed more evenly.

Thus, when the inflow port **11** is formed not directly above the shower spout **22** but is disposed on the straight stream spout **21** side (inside) off-center from the shower spout **22**, and even with a compact water spouting device having a short distance from the inflow port **11** to the shower spout **22**, it is possible to disperse the water streams evenly to the shower spout **22** and to distribute the flow velocity evenly across the shower spout **22**. When the inflow port **11** is disposed eccentrically (off-center) on the straight stream spout **21** side, it is preferable that the central axis in the jetting direction of the inflow port **11** is disposed on the straight stream spout **21** side eccentric (off-center) to the center between the center in the radial direction of the shower spout **22** and the wall surface of the shower flow passage **24**.

The flow rate of the water stream Wb which is the guiding water stream is higher than the flow rate of the water stream Wa which is the directly advancing water stream.

In this embodiment, a part of the water stream Wb being the guiding water stream is not merged with the water stream Wa being the directly advancing water stream. Since the water stream Wb is turned in direction upon hitting the planar guide wall **24***c*, the water stream Wb flows while spreading in the direction penetrating the plane of the sheet of FIG. **4**. On the other hand, since the water stream Wa advances directly without crashing against any wall, it flows in a narrower stream than the water stream Wb. Thus, since

a part of the water stream Wb is guided toward the outside of the shower spout **22** without being influenced by the water stream Wa, the water streams can be dispersed more evenly.

In the foregoing embodiment, the shower spout **22** is disposed on the outside and the straight stream spout **21** is disposed on the inside. However, the configuration of the spout cap **1** according to the present invention shall not be limited to this example. For example, the shower spout **22** may be disposed on the inside and the straight stream spout **21** may be disposed on the outside. Moreover, while in the foregoing embodiment, air is suctioned from the shower spout **22** and the straight stream spout **21**, the present invention is not limited to this example. In the spout cap **1** according to the present invention, air may be suctioned from other places.

The embodiment of the present invention has been described with reference to specific examples. However, the present invention is not limited to these specific examples. That is, these specific examples with appropriate design changes added thereto by those skilled in the art are also encompassed in the scope of the present invention as long as such examples have the features of the present invention. For example, the components of the above-described specific examples, and their arrangement, materials, conditions, shapes, etc. are not limited to those illustrated but can be appropriately changed. In addition, the components of the embodiment can be combined as far as technically possible, and these combinations are also encompassed in the scope of the present invention as long as such combinations have the features of the present invention.

What is claimed is:

1. A water spouting device which generates and spouts air bubble-entrained water by plunging water through an air-liquid interface between air and temporarily stored water, the water spouting device comprising: a first member which has an inflow port through which water flows in from a water supply source and which jets the water toward a downstream side; and a second member which has: a straight stream spout which spouts air bubble-entrained water as a single unified water stream; a shower spout which spouts air bubble-entrained water in the form of a shower; a straight stream flow passage extending from the inflow port side to the straight stream spout; and a shower flow passage extending from the inflow port side to the shower spout, wherein the straight stream spout and the shower spout are disposed in coaxial circles, changing the relative positional relation between the first member and the second member by rotating any one of the first member and the second member can switch between a first state, in which water flows through the straight stream flow passage and air is entrained into this water, and a second state, in which water flows through the shower flow passage and air is entrained into this water, the inflow port is eccentrically disposed relative to the center of the shower spout in the radial direction, and a dispersed water stream forming part is formed in the shower flow passage, the dispersed water stream forming part turning a part of a water stream flowing in from the inflow port into a guiding water stream, which flows toward the other end side in the radial direction of the shower spout, by causing it to crash against a guide wall, while turning the rest of the water stream into a directly advancing water stream, which flows toward the one end side in the radial direction of the shower spout, without causing it to crash against the guide wall and an inner wall surface of the shower flow passage, and merging the guiding water stream and the directly advancing water stream to form a dispersed water stream.

2. The water spouting device according to claim **1**, wherein the shower spout is formed at a position other than a region defined by projecting the inflow port in a jetting direction.

3. The water spouting device according to claim **1**, wherein

an air introduction part for introducing air, a water storage part for storing air bubble-entrained water, and a backflow prevention part, which is provided between the air introduction part and the water storage part and which has a smaller flow passage cross-sectional area than the water storage part so as to prevent backflow of air bubble-entrained water from the water storage part to the air introduction part side, are formed in the shower flow passage, and

the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the backflow prevention part toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

4. The water spouting device according to claim **1**, wherein the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the inflow port toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

5. The water spouting device according to claim **1**, wherein the dispersed water stream forming part is formed such that a part of a region, which is defined by projecting an outlet portion of the inflow port toward the downstream side and which is defined by a water stream diffusing at a spreading angle of 5 degrees after plunging through an air-liquid interface being an interface between air and air bubble-entrained water stored inside the shower flow passage, interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

6. The water spouting device according to claim **1**, wherein the dispersed water stream forming part is formed such that the flow rate of the guiding water stream becomes higher than the flow rate of the directly advancing water stream.

7. The water spouting device according to claim **1**, wherein the dispersed water stream forming part is formed such that a part of the guiding water stream is not merged with the directly advancing water stream.

8. The water spouting device according to claim **2**, wherein

an air introduction part for introducing air, a water storage part for storing air bubble-entrained water, and a backflow prevention part, which is provided between the air introduction part and the water storage part and which has a smaller flow passage cross-sectional area than the water storage part so as to prevent backflow of air bubble-entrained water from the water storage part to the air introduction part side, are formed in the shower flow passage, and

the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the backflow prevention part toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

9. The water spouting device according to claim 2, wherein the dispersed water stream forming part is formed such that a part of a region defined by projecting an outlet portion of the inflow port toward the downstream side interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

10. The water spouting device according to claim 2, wherein the dispersed water stream forming part is formed such that a part of a region, which is defined by projecting an outlet portion of the inflow port toward the downstream side and which is defined by a water stream diffusing at a spreading angle of 5 degrees after plunging through an air-liquid interface being an interface between air and air bubble-entrained water stored inside the shower flow passage, interferes with the guide wall, while the rest of the region interferes with the one end side in the radial direction of the shower spout without interfering with the guide wall.

11. The water spouting device according to claim 2, wherein the dispersed water stream forming part is formed such that the flow rate of the guiding water stream becomes higher than the flow rate of the directly advancing water stream.

12. The water spouting device according to claim 2, wherein the dispersed water stream forming part is formed such that a part of the guiding water stream is not merged with the directly advancing water stream.

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